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ABSTRACT

In the introduction to this report, it is noted that the quality of mathematics and science education in our schools depends to a great extent on the teachers in the classroom, and that the competency of the teachers depends on preservice preparation programs and state certification requirements which insure that minimum standards have been satisfied. The report describes the status of certification requirements for elementary and secondary mathematics and science teachers in the 14 states in the Southern Regional Education Board (SREB) region. The content of programs to prepare science and mathematics teachers is outlined. In addition, recommendations from the National Science Teachers' Association (NSTA) and the National Council of Teachers of Mathematics (NCTM) concerning certification and program standards are discussed relative to the SREB findings. (Author/MNS)

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Preparation Programs and Certification Standards for Teachers of Science and Mathematics in the SREB Region

Lynn M. Cornett

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Foreword

There is growing awareness that students graduating from our elementary and secondary schools are deficient in their knowledge of mathematics and science. The quality of instruction students receive depends to a large extent on an adequate supply of well prepared teachers. In its report, *The Need for Quality,* SREB's Task Force on Higher Education and the Schools directed attention to the continuing shortages of qualified mathematics and science teachers and urged the states to take actions that would address the problem, pointing out that the scarcity should not be used as an excuse to put inadequately educated personnel in the classroom.

This report provides an opportunity to compare science and mathematics requirements of teacher education programs in some of the region's leading institutions with the comprehensive guidelines for teacher preparation that have been developed by two important national organizations—the National Science Teachers' Association and the National Council of Teachers of Mathematics. In addition, current mathematics and science certification requirements for teachers at the elementary, middle school/junior high, and high school levels in each of the 14 SREB states are summarized.

It is our hope that this report will help states and institutions strengthen programs and standards.

Winfred L. Godwin
President

Introduction

The quality of mathematics and science education in our schools depends to a great extent on the teachers in the classroom. The competency of the teachers depends on pre-service preparation programs and state certification requirements which insure that minimum standards have been satisfied.

This report describes the status of certification requirements for elementary and secondary mathematics and science teachers in the SREB region. In addition, the content of programs to prepare science and mathematics teachers is outlined. The recommendations from two national groups, the National Science Teachers' Association (NSTA) and the National Council of Teachers of Mathematics (NCTM), concerning certification and program standards will be discussed relative to current certification requirements and preparation programs in the SREB region.

Science Teachers

Elementary Science Teaching

The following standards have been tentatively recommended by the National Science Teachers' Association (NSTA, 1982) concerning the science preparation of elementary teachers:

1. Twelve semester or 18 quarter hours of laboratory or field-oriented science, including courses in biological science, physical science, and earth science. The courses are to meet the needs of the elementary teacher.
2. Three hours in a separate elementary science methods course, to be taken after content courses and prior to student teaching.
3. Field experience with children throughout the undergraduate program, beginning with observations and culminating in student teaching.
4. Faculty assigned to teach the science content and methods courses, of the same quality as those assigned to teach courses in other academic majors.
5. Well-equipped science laboratories to provide resources comparable to teaching situations should be available.
6. Professional preparation which includes experiences to instill positive attitudes toward science and science teaching.

In the SREB region, the grades covered by elementary certificates vary considerably, according to a recent NSTA survey (see Table 1). The majority of the states' certification standards allow those with elementary certificates to teach at least through the sixth grade, with seven states extending certification through the eighth grade. All 14 states have science requirements for elementary teachers, but, with the exception of five states, those requirements are weak in terms of science content. Only half of the states require at least one course in biological science and one course in physical science. No state specifically requires the elementary teacher to have an earth science course, although in Tennessee, standards which go into effect in 1984 include an earth science requirement. Four states do require a separate course in elementary science methods.

A recent survey of science teacher preparation programs was conducted by the NSTA (Mechling, 1982). The sample was comprised of the 50 institutions belonging to the American Association of Colleges of Teacher Education (AACTE) that produced the largest numbers of graduates in 1979-80. Table 2 summarizes information for the 14 Southern institutions surveyed. Examination of their program requirements shows that in most cases the NSTA recommended standards on science content are not being met, but specific methods courses in science are required at all but one institution. Only three programs require courses in all three science areas: biological, physical, and earth. A majority of the deans from the Southern institutions felt that more science content should be required. Strengthening the general education component at the universities is seen as a way of improving the science preparation of elementary teachers (Mechling, 1982).

The majority of elementary school teachers do not feel comfortable in teaching science (Weiss, 1978). In a recent survey of elementary school teachers in 12 states (four in the SREB region), it was found that half of the teachers responding did not feel comfortable teaching topics in physical science (Donnellan, 1982). This needs to be addressed through science content requirements of pre-service preparation programs and certification standards.

Middle School/Junior High School Science Teaching

The National Science Teachers' Association (NSTA, 1982) offers tentative guidelines concerning the preparation of middle school/junior high school science teachers:

1. Separate, specific middle school/junior high school science certification programs designed for the teacher of early adolescents, with a minimum of 36 hours of science instruction, including at least nine semester hours of earth science, nine hours of biological science, and nine hours of physical science. The remaining nine hours are to be electives from the major science disciplines.
2. Supporting content should include a minimum of nine hours in mathematics and computer science instruction.
3. A specific science teaching methods course addressing current content and pedagogy of the early adolescent.
4. Internship of one semester or one quarter, supervised by a competent science teacher.

Certification standards for teachers of the middle school and junior high school grades vary tremendously, depending upon whether the teacher is an elementary teacher with a certificate valid up through the eighth grade, holds a secondary certificate which allows a teacher to teach any grade from seven through 12, or holds middle school or junior high school certification, as offered in some states (see Tables 1 and 3 and Figure 1). Seven of the SREB states—Kentucky, Louisiana, Maryland, Mississippi, South Carolina, Tennessee, and Texas—allow teachers with general elementary certificates (no science specialization) to teach middle school grades, usually up to and including eighth grade. Six of the states have specific middle school/junior high school science certification; however, most allow teachers with elementary certificates to teach science in the middle grades.

Four states—Alabama, Georgia, Kentucky, and North Carolina— have general middle school certification, with teachers usually choosing two specialty areas. In these states, teachers may teach science even when it is not one of their specialties. All states permit secondary science certificates to apply for middle school/junior high school grades (see Figure 1 for certification grade ranges).

Preparation programs designed specifically for middle school and/or junior high school teachers were found at nine of the 14 institutions in the NSTA survey (see Table 4 for complete data).

Comparison of the certification requirements in SREB states (Table 3) with NSTA middle school/junior high standards indicates that, except for those teachers with secondary certificates, the required science preparation does not meet the standards, and then it may include depth in one area rather than courses across the sciences. Only one state requires breadth in science—with courses in life, physical, and earth science. Examination of programs for the preparation of middle school/junior high school science teachers (Table 4) indicates that often the prospective junior high school teacher is concentrating on one science discipline, rather than taking a broad spectrum of courses. In some cases the methods courses are designed specifically for middle school/junior high school students, but often an elementary or secondary methods course is taken.

Pre-service programs are greatly influenced by certification standards in each state. States that permit general elementary certificates or middle school certificates with no science specialization allow the employment of middle school/junior high school teachers who may have insufficient background to teach science. On the other hand, those states which have 7-12 certification of science teachers may be placing teachers with highly specialized backgrounds as instructors in generalized science courses in middle and junior high schools. Many states do not require programs which address the content and pedagogy techniques appropriate for prospective teachers in the middle grades.

High School Science Teaching

High school science teachers must be able to provide in-depth preparation for specific disciplines for college-bound students, and courses for the students who may terminate their formal education at the high school level. The need for courses to provide these students with knowledge to become scientifically literate citizens is of utmost importance.

Among the SREB states, seven allow "broad field" certification to teach any science at the high school level, with 36 to 50 hours of science required (see Table 5). Earth science is often not a required subject. Teaching majors in a single subject require 16 to 30 hours in the specialty area. States that endorse a minor subject require from 16 to 24 hours in the subject area. The advantage of broad field certification is that it prepares teachers to serve in a variety of science disciplines, especially in smaller high schools that cannot staff enough specialists in various sciences. The disadvantage of the broad field certificate is that it is unlikely to produce great depth in any one science and instruction in some fields may be weak. Most states require a specific methods course or a general methods course.

Table 1

Science Certification Requirements for Elementary Teachers

	Grade Range	Required Hours	Science Methods Course Required
Alabama	N-3 4-6	12 hours of math and science	no
Arkansas	1-6	3 hours of biology, 3 hours of physical science	yes
Florida	1-6	6 hours of math and science	general methods or specific
Georgia	K-4 4-8	not specified for K-4 4-8: 45 quarter hours in 2 subjects, 20 quarter hours in an additional field	no
Kentucky	K-8 1-8	12 hours of math and science	yes
Louisiana	1-8	12 hours including biology, physical science	general methods
Maryland	1-8	12 hours including biology, physical science	general methods or specific
Mississippi	K-3 K-8	15 hours science and math including 3 hours of biology, 3 hours of physical science	yes
North Carolina†	K-3 4-9	competence required in general education	general methods
South Carolina	1-8	12 hours including biology, physical science	no
Tennessee	1-8	12 quarter hours As of 9/1/84: 18 quarter hours to include 6 quarter hours of biology, 6 quarter hours of physical science (includes earth science), plus electives	no (may be included in required hours)
Texas	K-8	12 hours in two fields: math, science, or foreign language	general methods
Virginia	NK-3 4-8	12 hours of math and science including 1 lab course and 6 hours of life science and physical science	general methods
West Virginia	1-6	12 hours	yes

NOTES: Hours are semester hours unless otherwise noted.
N stands for nursery school certification; K for kindergarten certification.

†North Carolina's certification requirements are based on competency standards outlined in program approval authorization.

SOURCES: Stedman, C.H. and Dowling, K. *State Requirements for Teacher Certification in Science*, Washington, D.C.: National Science Teachers' Association, 1982; and State Departments of Education.

Table 2

Science Content and Methods Requirements in Selected Preparation Programs for Elementary Teachers

	Science Content Required			Content	Specific
	Specific Courses	Biological, Physical, and Earth Sciences	Hours in Content	Designed for Teachers	Science Methods Required
Appalachian State University (North Carolina)	yes	yes	12	yes	yes—3 hours
Georgia State University	no	no	15 quarter hours	no	yes—5 quarter hours
East Texas State University	no	no	8	no	yes—3 hours
North Texas State University	yes	no	4	no	yes—3 hours
East Carolina University (North Carolina)	yes	yes	8	yes	yes—2 hours
Pan American University (Texas)	yes	no	6	yes	yes—3 hours
University of Alabama	yes	no	11	6 hours designed for teachers	yes—3 hours
University of Alabama in Birmingham	yes	no	6 to 9	no	yes—3 hours
University of Georgia	no	no	15 quarter hours	options available	yes—5 quarter hours
University of Houston (Texas)	no	no	6	no	yes
University of South Carolina	yes	yes	16 to 18	no	yes—3 hours plus 3 hours of general methods
University of Tennessee at Knoxville	no	no	20 quarter hours	no	yes—3 quarter hours
University of Texas at Austin	no	no	6 to 9	no	optional
Western Kentucky University	no	no	6	no	yes—3 quarter hours

NOTE: Hours are semester hours unless otherwise noted.

SOURCE: Mechling, K. *Preservice Preparation of Teachers of Science at the Elementary, Middle, and Junior High School Levels*, Washington, D.C.: National Science Teachers' Association, 1982.

Table 3

Requirements for Middle School/Junior High Science Teaching

	Required to be Certified as Science Teacher	Certificate Level	Science Content Required
Alabama	no	6-9	27 hours in each of two fields or 9 hours each of chemistry, earth science, biology, physics*
Arkansas	yes	5-9	18 hours in subject with elementary or secondary certificate
Florida	yes	7-9	18 hours of physics, biology, earth science
Georgia	no	4-8	25 quarter hours in 3 sciences*
Kentucky	no	5-9	24 hours in each of two teaching fields plus 12 hours in an additional field*
Louisiana	no	1-8 7-12	12 hours for elementary certification or 24 hours for secondary certification
Maryland	no	1-8 7-12	12 hours for elementary certification or 36 hours for secondary certification
Mississippi	no	1-8 7-12	15 hours for elementary certification or 32 hours of science with 16 in a specialty for secondary certification
North Carolina†	no	4-9	25 to 40% of time*
South Carolina	no	7-8	20 hours if science a middle school specialty (not mandatory)
Tennessee	no	1-8 7-12	12 quarter hours for elementary certification or 24 quarter hours for secondary certification
Texas	yes	6-10	24 hours in each of two fields including 12 hours advanced work
Virginia	yes	4-8	general education requirement of 3 hours plus 15 hours in life, physical, and environmental science
West Virginia	yes	4-8 7-9	24 hours of general science

NOTES: Hours are semester hours unless otherwise noted.

†North Carolina's certification requirements are based on competency standards outlined in program approval authorization.

*If science is chosen as a specialty.

SOURCES: Stedman, C.H. and Dowling, K. *State Requirements for Teacher Certification in Science.* Washington, D.C.: National Science Teachers' Association, 1982; and State Departments of Education.

Table 4

Science Content and Methods Requirements in Selected Preparation Programs for Middle School and Junior High School Teachers

	Middle School		Junior High	
	Programs Designed Specifically for Middle School Teachers	Content and Methods Requirements	Programs Designed Specifically for Junior High Teachers	Content and Methods Requirements
Appalachian State University (North Carolina)	yes	21 to 23 hours of science if a specialty; 3 hours of elementary or secondary methods	yes	21 to 23 hours of science if a specialty
East Texas State University	yes	28 to 36 hours of science or elementary certificate plus minor in a discipline if science is 1 of 2 content areas; math/science methods	yes	28 to 36 hours in science or elementary certificate plus minor in discipline; math/science methods
East Carolina University (North Carolina)	yes	elementary requirement of 8 hours plus 8 hours if science is 1 of 2 content areas; elementary methods	no	
Georgia State University	yes	30 quarter hours of content if science is 1 of 2 content areas; middle school methods	no	
North Texas State University	no		no	
Pan American University (Texas)	no		no	
University of Alabama	no		yes	48 hours for comprehensive science or 28 to 32 hours in one subject if chosen as one of 2 specialties; secondary methods
University of Alabama in Birmingham	no		yes	42 hours including 12 hours in biology, 12 hours in physics, 9 hours in chemistry, 9 hours in earth sciences; junior high methods
University of Georgia	yes	40 quarter hours if science is 1 of 2 content areas; middle school methods	yes	75 quarter hours in science (same as 7-12); secondary methods
University of Houston	no		no	
University of South Carolina	no		yes	60 to 63 hours including biology, chemistry, physics, earth science plus electives; secondary methods
University of Tennessee at Knoxville	no		no	
University of Texas at Austin	no		no	
Western Kentucky University	yes	30 hours if major or 18 hours if minor or 67 hours general science or 58 hours including physical science and math; elementary or secondary methods		

SOURCE: Mechling, K. *Preservice Preparation of Teachers of Science at the Elementary, Middle and Junior High School Levels.* Washington, D.C.: National Science Teachers' Association, 1982.

Table 5

Certification Requirements for High School Science Teachers

	Broad Field Certification	Content for Broad Field Certification	Content for Specialty Certification	Methods Required
Alabama	yes	minimum of 52 hours including 12 hours each in biology, chemistry, earth science, and physics	27 hours each in 2 fields	general secondary
Arkansas	no		24 hours	study of teaching
Florida	no		20 hours or major	secondary science
Georgia	yes	75 quarter hours including biology, chemistry, earth science, and physics	40 quarter hours	general secondary
Kentucky	yes	48 hours including biology, chemistry, physics	30 hours	none
Louisiana	no		20 hours in specialty in addition to 12 hours general education requirements; if specialty is general science, 32 hours including 8 hours each in biology, chemistry, earth science, and physics	general secondary
Maryland	yes	36 hours with at least 18 hours in one major with 6 hours in two additional areas	24 hours	general secondary or specific science
Mississippi	no		32 hours science with 16 hours in specialty	secondary science
North Carolina†	yes	biology, chemistry, physics required	25 to 40 percent of program in subject matter preparation	instruction in creating learning environments
South Carolina	yes	42 hours including biology, chemistry, and physics plus electives	30 hours; general science only: 18 hours with 12 hours in a specialty	specific science
Tennessee	no		48 quarter hours in 3 sciences or 24 quarter hours in specialty	general secondary
Texas	yes	48 hours including biology, chemistry, earth science, and physics	24 hours in each of 2 fields	general secondary
Virginia	no		24 hours	general secondary
West Virginia	no		24 hours	specific science

NOTES: All hours are semester hours unless otherwise noted.

†North Carolina's certification requirements are based on competency standards outlined in program approval authorization.

SOURCES: Stedman, C.H. and Dowling, K. *State Requirements for Teacher Certification in Science*, Washington, D.C.: National Science Teachers' Association, 1982; and State Departments of Education.

Figure 1

Grade Ranges for Middle School/Junior High Science Certifications in the SREB States

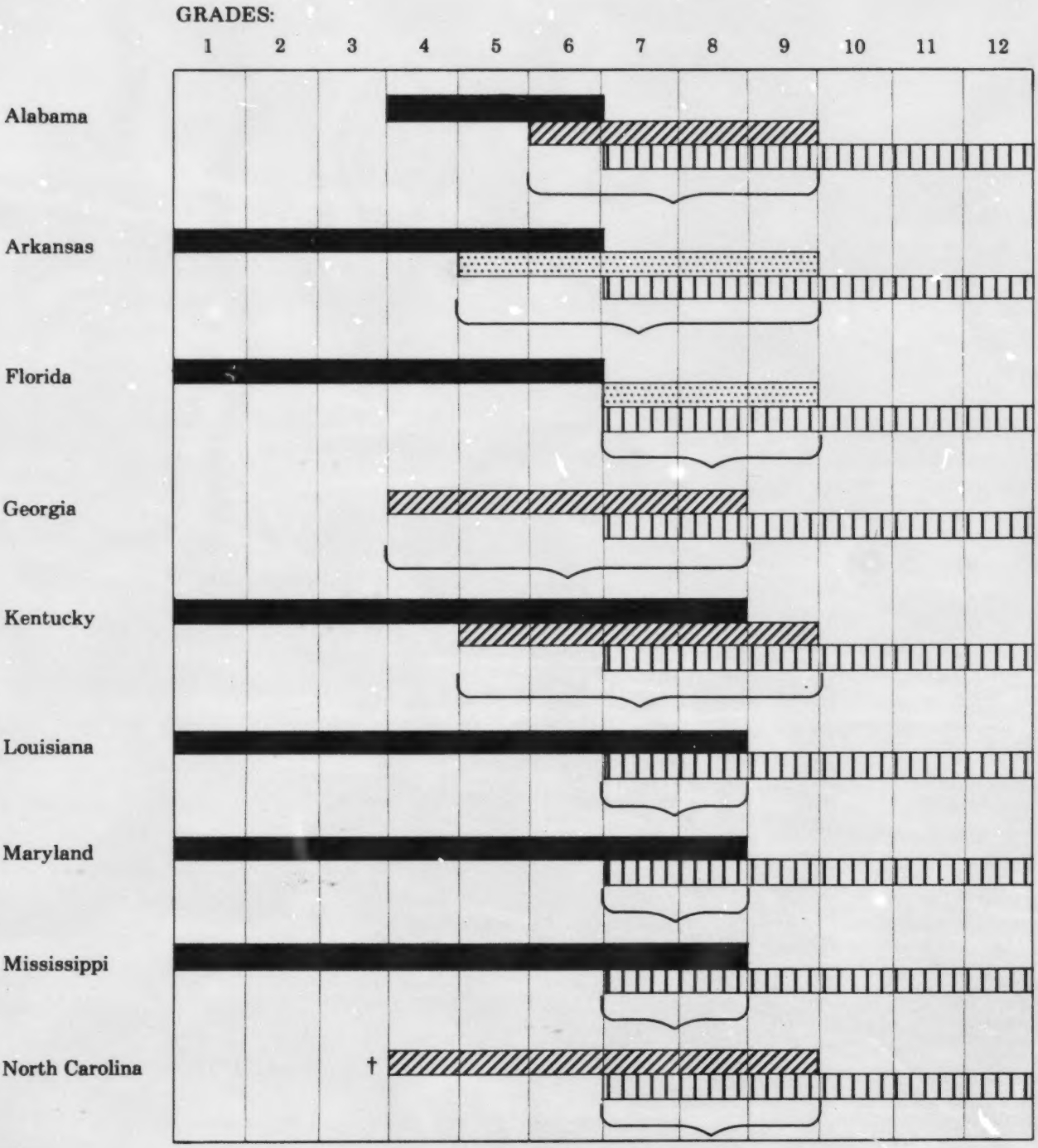
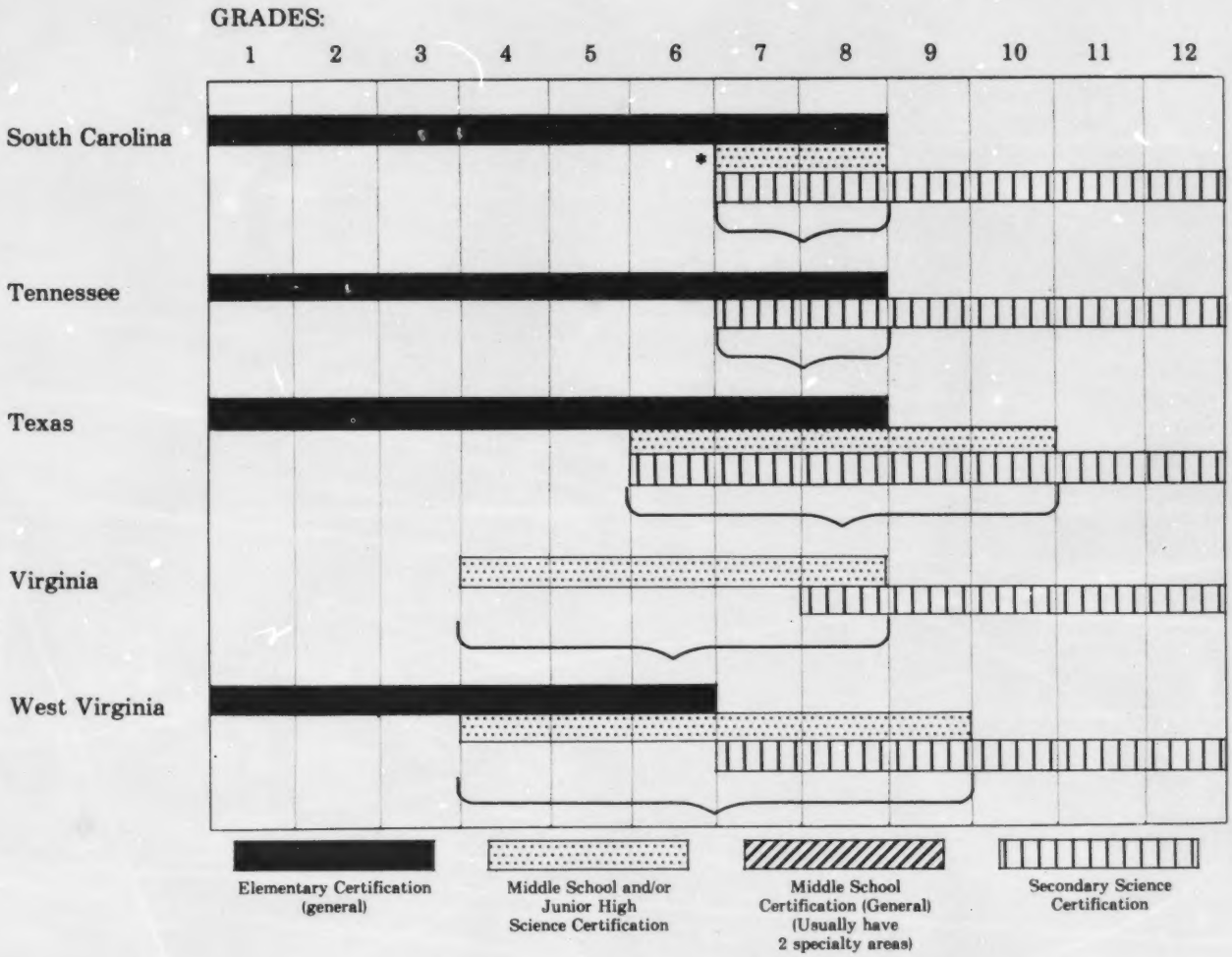


Figure 1 (continued)

Grade Ranges for Middle School/Junior High Science Certifications in the SREB States



† intermediate/middle school

* optional

NOTE: Brackets denote grade ranges for Middle School/Junior High

SOURCES: Stedman, C.H. and Dowling, K. *State Requirements for Teacher Certification in Science.* Washington, D.C.: National Science Teachers Association, 1982; and State Departments of Education.

Mathematics Teachers

Preparation Guidelines for Mathematics Teaching

The guidelines prepared by the National Council of Teachers of Mathematics (NCTM, 1981) integrate the thoughts of mathematicians and mathematics educators from all levels of instruction. They are endorsed by the Mathematical Association of America and the Conference Board of the Mathematical Sciences. Stated as competencies that graduates of teacher education programs should be able to meet, lists of courses are given which presumably would cover those competencies. Laboratory and clinical experiences are recommended as part of the program, with the recommendation that they should start as early as the sophomore year. The prospective teacher should be familiar with the nature and aims of education, school organization, and curriculum and behavioral studies. Faculty members teaching courses should have the appropriate knowledge base for the level that they are teaching and have continuing contact with the schools. The following summarizes the courses recommended by the NCTM:

Semester Hours Recommended for the Preparation of Elementary and Middle School Teachers of Mathematics

	Semester Hours	
	Early Childhood, Primary School (ages 4-8)	Upper Elementary, Middle School (ages 8-12)
Number systems through the rational numbers*	3	3
Informal geometry (mensuration, graphing, geometrical constructions, similarity and congruence)	3	3
Topics including real number system, elementary probability and statistics, coordinate geometry, number theory		3
Mathematics methods course designed for appropriate grade level, including methods of diagnosis and remediation	3	3
	9	12

*Assumes as prerequisite high school background of two years of algebra and one year of geometry.

SOURCE: Commission on the Education of Teacher of Mathematics. *Guidelines for the Preparation of Teachers of Mathematics, 1981.* Reston, Virginia: National Council of Teachers of Mathematics, 1981.

Semester Hours Recommended for the Preparation of Junior High and Senior High School Mathematics Teachers

	Semester Hours	
	Junior High (ages 12-14)	Senior High
Calculus (differentiation and integration)*	3	9
Geometry (informal approaches, axiomatics, formal proof)	3	
Computer science using high level programming language	3	3
Abstract algebra including number theory	3	3
Mathematics course including applications and topics from fields such as science, social sciences, business, and engineering	3	3
Probability and statistics	3	3
Linear algebra		3
Geometry including Euclidian and other geometries		3
Selected topics from the curriculum, taught from an advanced point of view		3
History of mathematical sciences		3
Elective from differential equations, number theory, combinatorial analysis, graphs, logic, mathematical programming		3
Mathematics methods course designed for appropriate grade level including methods of diagnosis and remediation	3	3
	21	39

*Assumes as prerequisite at least three and preferably four years of high school mathematics, starting with algebra and extending through trigonometry.

SOURCE: Commission on the Education of Teacher of Mathematics. *Guidelines for the Preparation of Teachers of Mathematics.* Reston, Virginia: National Council of Teachers of Mathematics, 1981.

Preparation Programs for Teaching of Mathematics

An examination of recent catalogs describing the pre-service undergraduate programs to prepare elementary teachers at the major public institution in each of the SREB states reveals that the mathematics requirements in these programs are very similar (see Table 6). These programs may not be entirely representative of other state institutions, but they do graduate substantial numbers of the education majors.

The majority of the institutions require six to nine semester hours or the equivalent quarter hours in mathematics for the elementary teacher. (These courses usually cover number theory, linear equations, and informal geometry.) The prerequisite is generally one year of high school algebra. In several institutions the hours in mathematics for elementary teachers are in addition to the math requirement of the general education component of the university; in others, the hours fulfill the general education requirement. In some instances,

all students in the university are allowed to substitute courses such as philosophy, psychology, and logic for the mathematics courses in the general education state requirements. A majority of the programs do require a course in elementary mathematics methods and/or materials.

Program requirements for the mathematics preparation of elementary teachers are in line with the NCTM guidelines in terms of hours required, with one major difference: the NCTM assumes two years of algebra and one year of high school geometry before the college courses are taken. Yet, the prerequisite for most math courses taken by prospective elementary teachers in the SREB region is only one year of high school algebra.

There appears to be greater similarity in programs to prepare secondary mathematics teachers than in those for the middle school/junior high school teacher. Requirements for the middle school/junior high programs tend to have content concentrations of 15 to 30 hours, with a few of the institutions offering methods or curriculum courses designed specifically for the middle school or junior high school teacher. Several institutions offer only elementary or secondary teacher preparation courses.

Preparation programs for the high school teacher have content requirements which range from approximately 22 to 36 or 40 hours in mathematics. Most institutions in the survey require a methods course in mathematics. Six of the institutions require at least one course in computer usage. However, due to recent trends in this field, the inclusion of computer courses may not have shown up in the catalogs surveyed.

Programs for the middle school or junior high school teacher need to be differentiated in terms of content and pedagogy along the lines recommended by the National Council of Teachers of Mathematics. The requirements for the secondary teacher appear to be weak, in some cases lacking courses on the history of mathematics, computer science, and applications to other fields such as business or science. However, close examination of course content would be necessary for adequate evaluation, because the lack of certain coverages cannot be ascertained from catalog course descriptions.

Certification Standards for Mathematics Teachers

Certification standards in the SREB states represent minimums in terms of preparation program requirements. General education requirements usually include a mathematics and science component. Several states require that additional courses be taken in mathematics for elementary teachers (see Table 7 for summary). In most states it is possible to teach in the middle school/junior high school grades with a variety of certificates that cover various grade levels (see Table 8). Elementary and secondary certificates, in many cases, permit the teaching of math in the middle school/junior high school grades. Standards for secondary certification usually include content requirements of from 21 hours to a major in mathematics.

Certification standards generally reflect the NCTM standards for elementary teachers, although a number of states require only six hours of content preparation. The specification for methods courses that address diagnosis and remediation of mathematics competencies is not specific in any standards, but may be included in general or specific mathematics methods courses required. Differentiation in certification for middle school teachers needs to be addressed, so that persons with elementary certification—requiring less mathematics concentration—are not certified to teach mathematics in the middle/junior high school. Secondary requirements should be examined to see that they include modern trends in mathematics, such as computer mathematics and application of mathematics to related fields.

Table 6
Mathematics Content and Methods Requirements in Selected Preparation Programs for Elementary, Middle School/Junior High, and Senior High Teachers

	Elementary Content and Methods Requirements	Middle School/Junior High Content and Methods Requirements	Senior High Content and Methods Requirements
University of Alabama† 1982-1984	3 hours math for elementary teachers, 3 hours methods of math	30 hours if math is chosen as specialty, computer science included; middle school math methods	30 hours including computer science plus 6 additional hours recommended; secondary methods
University of Arkansas 1982-83	6 hours math for elementary teachers; 3 hours methods of math	18 hours; middle school methods	22 hours, 18 hours to teach basic math; 3 hours secondary methods
University of Florida 1982-83	3 hours math for general education plus 3 hours math for elementary teachers	10 hours beyond general education	31 hours including 3 hours computer science
University of Georgia 1982-1983	15 quarter hours which include 10 quarter hours math for elementary teachers; 5 quarter hours methods of math	30 quarter hours if chosen as 1 of 2 specialties	20 to 25 quarter hours plus 9 upper division courses including one class in computer science; 5 quarter hours secondary methods
University of Kentucky 1982-83	4 to 6 hours math or 6 hours logic and philosophy for general education plus 6 hours math for elementary teachers; 3 hours methods of math	24 hours if chosen as 1 of 2 specialties, includes 6 hours in new math concepts	30 to 36 hours plus 24 hours in related field; 3 hours secondary methods
Louisiana State University 1981-1982	6 hours math for elementary teachers; 3 hours methods of math		40 hours including computer science; 2 hours secondary methods
University of Maryland at College Park 1982-83	9 hours mathematics; 3 hours methods of math		31 hours including computer science; 3 hours secondary methods
University of Mississippi 1982	6 hours math for elementary teachers plus 3 hours math or science elective; 3 hours methods of arithmetic	18 hours if chosen as a specialty	27 hours; 3 hours secondary methods
University of North Carolina at Chapel Hill 1982-83	6 hours	15 hours if chosen as a specialty	academic major including computer science; 3 hours mathematics or science methods
University of South Carolina 1982-83	6 hours math for elementary teachers; 3 hours methods of math	22 hours if chosen as a specialty; 3 hours methods	37 hours plus 16 hours science; 3 hours secondary methods
University of Tennessee at Knoxville 1981-1982	9 quarter hours; 3 quarter hours methods of math		45 quarter hours plus a minor; 3 quarter hours of secondary methods
University of Texas at Austin 1982-1984	6 hours math for elementary teachers; 3 hours methods of math are optional		2 subject field specializations are required: 24 to 26 hours in addition to general education requirements; 3 hours secondary methods
University of Virginia 1980-1982	3 hours math plus 3 hours math for elementary teachers; 3 hours methods of math		30 hours; 3 hours secondary methods
West Virginia University 1982-83	9 hours math for elementary teachers; 3 hours methods of math	15-30 hours above the requirements for elementary certification	30 hours with an additional field; 3 hours secondary methods

NOTES: All information was obtained from published catalogs for academic years noted.
All credit hours are semester hours unless otherwise noted.
†As of fall semester 1983 all students must take 6 hours math at or above the level of college algebra.

Table 7

Mathematics Certification Requirements for Elementary Teachers in the SREB States

	Content and Methods Requirements
Alabama	12 hours math and science
Arkansas	6 hours math for elementary teachers
Florida	6 to 12 hours math and science; arithmetic methods
Georgia	Grades K-4: 10 quarter hours science and math for children Grades 4-8: 25 quarter hours if math is a specialty, if not, 10 quarter hours; 10 quarter hours curriculum and methods
Kentucky	12 hours math and science plus 6 hours math for elementary teachers; process and learning materials
Louisiana	6 hours; 3 hours in materials of instruction
Maryland	6 hours math for elementary teachers; methods of mathematics
Mississippi	15 hours science and math with a minimum of 6 hours math plus 3 hours math for children; general methods
North Carolina†	Program approval
South Carolina	6 hours; teaching arithmetic or general methods
Tennessee	3 quarter hours for general education plus 6-quarter hours math; general methods. As of 9/1/84, 3 quarter hours math methods
Texas	12 hours in two of the following fields: math, science, foreign language
Virginia	6 hours; general methods
West Virginia	general studies include math and science plus 6 hours math for elementary teachers; curriculum materials and methods

NOTES: All hours are semester hours unless otherwise noted.

†North Carolina's certification requirements are based on competency standards outlined in program approval authorization.

SOURCES: Woellner, E.H. *Requirements for Certification, 1982 83* (47th ed.), Chicago: University of Chicago Press, 1982; and State Departments of Education.

Table 8

Mathematics Certification Requirements for Teachers at the Middle School/Junior High School Level in the SREB States

	Certificates Which Cover Middle School/Junior High	Mathematics Content Requirements
Alabama	elementary (grades 4-6)	12 hours math and science
	middle/junior high (grades 6-9)	27 hours in two fields including one-third upper level courses
	secondary (grades 7-12)	27 hours in two fields including one-third upper level courses
Arkansas	elementary (grades K-6) teach through 8th grade	elementary certificate with 18 hours math
	middle school (grades 5-9)	secondary certificate with at least 18 hours math
	secondary (grades 7-12)	21 hours including 3 hours calculus
	As of September 1984: basic math in grades 7 and 8 or general or basic math in grades 9-12	18 hours math including geometry and algebra above the intermediate level
Florida	middle school/junior high (grades 7-9)	12 hours math at the level of algebra and above
	secondary (grades 7-12)	21 hours math or certified in physics plus 15 hours math including calculus
Georgia	middle school (grades 4-8)	45 quarter hours in two areas, 25 quarter hours if math a specialty, must include algebra and geometry
	secondary (grades 7-12)	45 quarter hours which may include 10 quarter hours in physics and must include 5 quarter hours in calculus
Kentucky	elementary (grades 1-8)	12 hours math and science plus 6 hours math for elementary teachers
	middle school (grades 5-9)	24 hours in each of two areas with additional concentration of 12 hours, math must include 6 hours in new concepts of math
	secondary (grades 7-12)	30 hours math or 48 hours math and physical science, with at least 15 hours in math
Louisiana	elementary (grades 1-8)	6 hours math
	secondary (grades 7-12)	20 hours in addition to general education, must include at least 3 hours calculus and only 9 hours can be freshman courses
Maryland	elementary (grades 1 through 8 if middle school organization)	6 hours math
	elementary (grades 7-9)	content requirements for secondary certificate
	secondary (grades 7-12)	24 hours including at least 18 hours of college math content
Mississippi	elementary (grades K-8)	9 hours math including 3 hours math for children
	secondary (grades 7-9)	18 hours math
	secondary (grades 7-12)	24 hours including calculus or computer science
North Carolina†	intermediate (grades 4-9)	competency based
	secondary (grades 7-12)	competency based

Table 8 (continued)

Mathematics Certification Requirements for Teachers at the Middle School/Junior High School Level in the SREB States

	Certificates Which Cover Middle School/Junior High	Mathematics Content Requirements
South Carolina	elementary (grades 1-8)	must meet middle school content requirements
	middle school (grades 7-8)	15 hours math
	secondary (grades 7-12)	24 hours math including calculus
Tennessee	elementary (grades K-8)	9 quarter hours math
	secondary (grades 7-12)	30 quarter hours including college algebra, trigonometry, and analytical geometry
Texas	elementary (grades K-8)	12 hours in two of the following fields: math, science, foreign language
	junior high (grades 6-10)	24 hours in each of two subjects including 12 hours advanced work in each
	secondary (grades 6-12)	24 hours in each of two subjects including 12 hours advanced work in each
Virginia	middle school (grades 4-8)	15 hours math plus one other endorsement area
	secondary school (grades 8-12)	27 hours including calculus and applications of mathematics, course in statistics or computer science required
	general mathematics (grades 8-12) (general, consumer, basic, career, and shop)	18 hours in general math, algebra, geometry, probability and statistics
West Virginia	elementary (grades 1-6)	general education requirements plus 6 hours math for elementary teachers
	middle school (grades 4-8)	12 hours math
	junior high (grades 7-9)	18 hours math
	secondary (grades 7-12)	30 hours including calculus

NOTES: Hours are semester hours unless otherwise noted.

†North Carolina's certification requirements are based on competency standards outlined in program approval authorization.

SOURCES: Woellner, E.H. *Requirements for Certification* (47th ed.). Chicago: University of Chicago Press, 1982; and State Departments of Education.

Conclusions

Preparation programs and certification standards for science and mathematics teachers in the SREB states have been analyzed in light of the recommendations in the national guidelines from the National Science Teachers' Association and the National Council of Teachers of Mathematics.

Areas of particular concern include the science preparation of elementary teachers. The amount and breadth of required science should be addressed so that programs include requirements in the biological, physical, and earth sciences, rather than permitting concentration in only one area. This could be accomplished with stronger general education requirements decided upon by faculty from the arts and science and from education.

Also of concern is the mathematics preparation for the elementary teacher. The course designed for elementary teachers assumes only a background of first year algebra, in most cases. The NCTM guidelines stress that, for the elementary teacher, a background of three years of high school mathematics is assumed (two years of algebra and one year of geometry) before the required college courses.

Programs to prepare middle school/junior high school teachers need to be planned so that classrooms will stimulate an interest in science and math in these students, who are at the age where they are most responsive to challenge and inquiry. The science content should cover all fields—earth science, physical science, and biological science. The mathematics and science content should be beyond that needed by the elementary teacher. A teacher should be prepared to be a teacher in the middle school or junior high school, not as an elementary or high school teacher who happens to end up teaching a seventh or eighth grade class.

The fact that only a few programs reviewed include early classroom experiences in the form of observation and working with students is of concern. The guidelines for both science and mathematics teachers indicate that early experiences in the classroom are important in the programs to prepare teachers at all levels. Arts and sciences faculty, from the mathematics and science disciplines, and education faculty should be included in developing preparation programs that include modern trends, such as the use of computers and applications of mathematics to related fields, and bridge the gap between the disciplines and the methodology to be used in the classroom.

Certification standards need to be addressed, both in terms of the standards themselves and whether or not teachers are actually being assigned in their specialty fields. The assignment of teachers with generic middle school certification to teach out-of-field may be common. In addition, the assignment of teachers with specialty certificates to out-of-field positions is of concern.

North Carolina has documented out-of-field teaching and reports that for grades 7-12, 37 percent of those teaching mathematics in 1980-81 did not possess mathematics certification and three out of every 10 science teachers lacked proper certification for the classes they taught. It was most prevalent for grades 7-9 (Woolford, Presti, Gray, & Coble, 1982).

A 1982 survey (Woolford et. al., 1982) reveals that of the 14 SREB states, five—Alabama, Maryland, North Carolina, Texas, and Virginia—have no state provisions prohibiting out-of-field teaching. Three SREB states—Arkansas, Louisiana, and West Virginia—have both rules and laws prohibiting out-of-field teaching; the remaining SREB states have rules to prohibit the practice. States may need to document this problem, and pose solutions, especially in the face of the growing shortage of mathematics and science teachers.

Another issue may be the question of specificity of certificates for middle school/junior high school and senior high school teachers. What is the needed depth and breadth for middle school teachers? Should teachers with general elementary certificates be allowed to teach in the middle school? Should science certification be specific for subject area? Institutions of higher education and state departments of education, with input from teachers, should jointly address these questions in science and mathematics education, drawing on the extensive work that has already been done by the National Science Teachers' Association and the National Council of Teachers of Mathematics.

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